SOUTHERN CALIFORNIA EDISON®

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DRP Demonstration Workshop

Demo D -Distribution Operations at DER High Penetration

June 28, 2016

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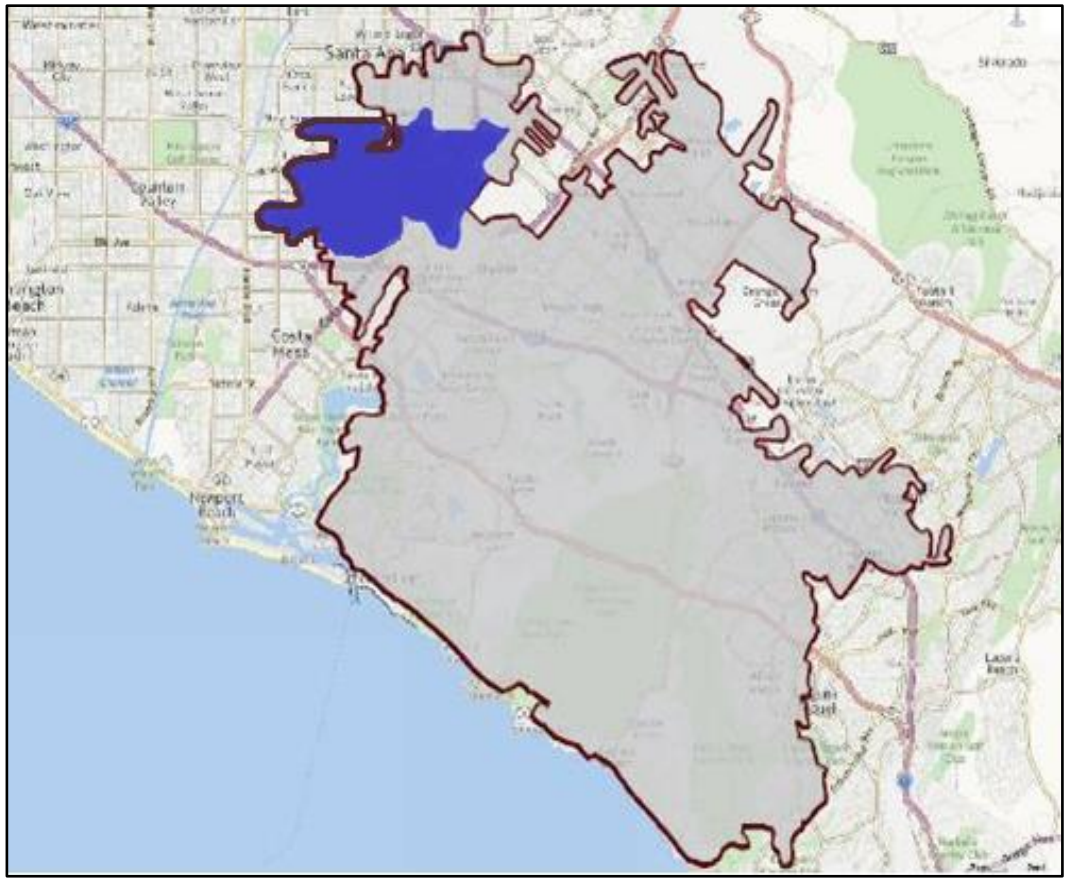
Demo D Objective and Expected Outcome

Objective:
Demonstrate a system that can operate multiple DERs (both third-party-owned and utility-owned) to provide grid benefits and assess how high penetration of DERs will influence distribution planning and investments

Expected Outcome:
Provide a technology test bed to prepare the utility to plan and operate a grid with high penetration of various types of DERs



Integrated Grid Project within PRP Area (Johanna Jr & Camden substation)

Demo D: Summary of Project Proposal

Scope

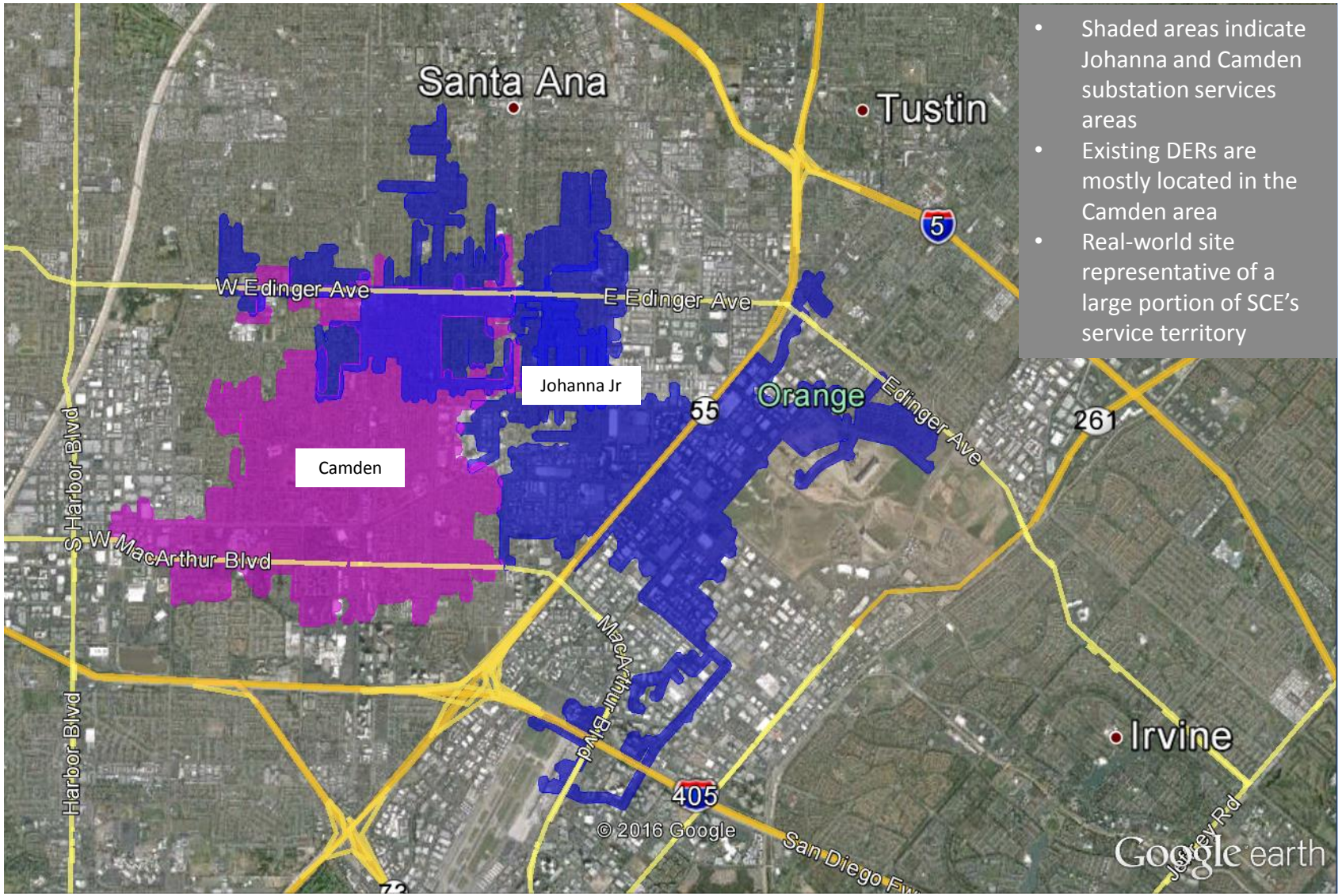
- Plan, design and deploy grid modernization infrastructure to enable high penetration of DERs
- Design and deploy control systems and protocols to coordinate and optimize operations of multiple DERs (customer-, 3rd party- and SCE-owned)
- Field demonstrate the ability to operate an integrated distribution system to provide safe and reliable service
- SCE estimated cost: $23.7 (100% IGP EPIC Funded)

Approach

- Install advanced substation and distribution automation equipment to provide control and monitoring
- Deploy telecommunications and advanced control systems to enable volt/VAR and power flow optimization applications
- Utilize centralized and distributed systems to optimize DER
- Provide DER visualization tools to assist system operators with system reconfiguration
- Measure performance of DERs based on operational experience

Key Milestones	
Project initiated following CPUC Decision	Q4 2016
Complete technical requirements specification	1Q 2017
Select existing 3rd party DERs and sign contracts	Q2 2017
Complete control system lab tests	Q3 2018
Initiate field testing (M&V)	Q2 2018
Complete M&V	Q2 2019
Issue final report	Q1 2020

Proposed Location Overview

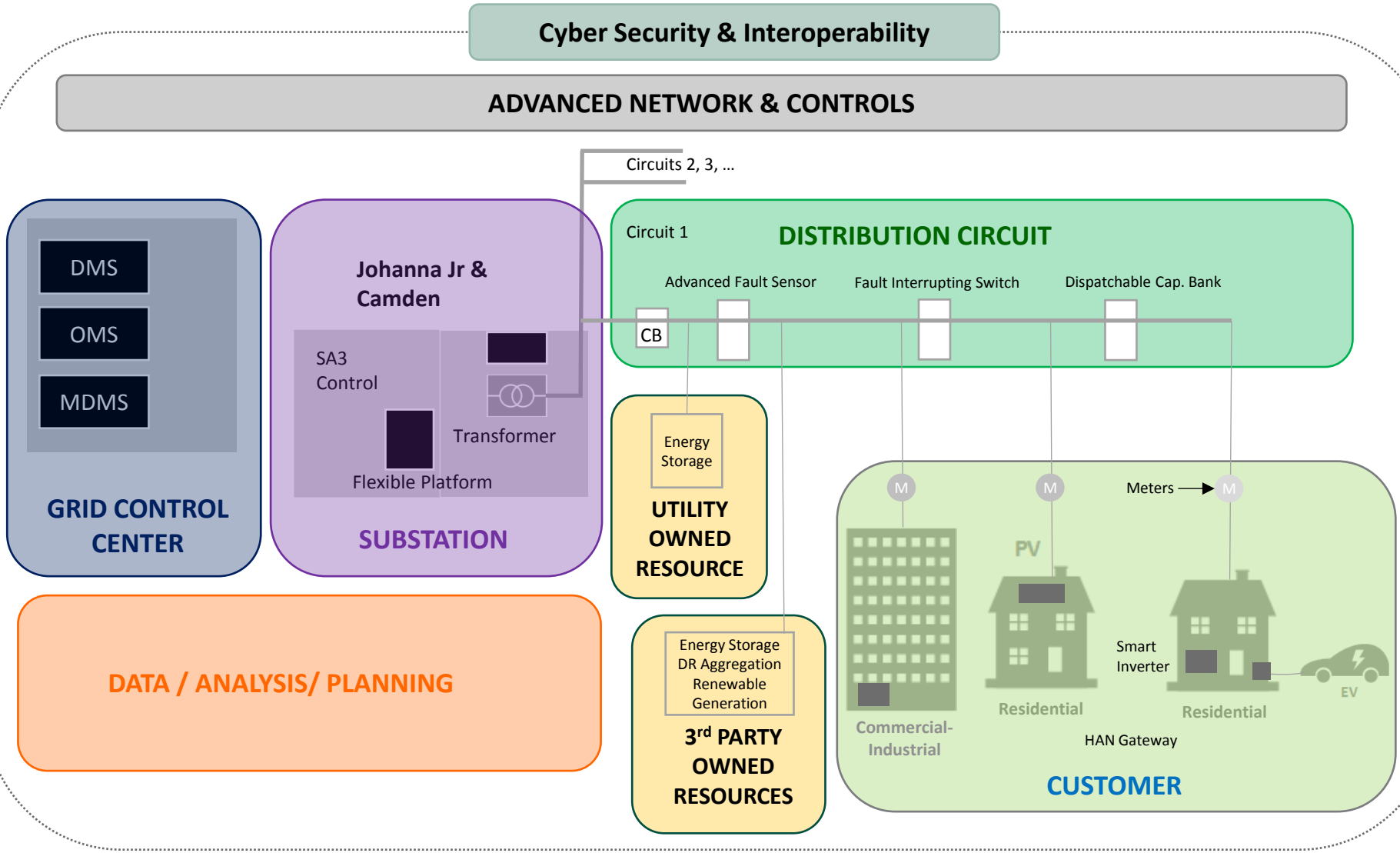


- Shaded areas indicate Johanna and Camden substation services areas
- Existing DERs are mostly located in the Camden area
- Real-world site representative of a large portion of SCE's service territory

Demo D Rationale

- Proposal leverages existing projects and programs
  - Integrated Grid Project, Preferred Resource Pilot, SCE energy storage deployments, CEC EPIC funding (Sunspec Alliance and EPRI projects)
- Scalable system capable of being transferred to the rest of the system
  - Utilize standard protocols, integrate with existing SCE systems, implement cyber secure systems, and deploy new FAN communications system
- Prove-out several emerging technologies
  - Advanced volt/VAR and power flow control with DERs, increased operator situational awareness with DER, and next generation distribution automation equipment
- Sited with existing DER penetration and more expected
  - PV, storage, and demand response mix
  - One circuit with 50+% and 3 with 10 – 15% penetration in 2017
  - Will add SCE-owned battery storage (pilot project)
  - Will add resources resulting from PRP solicitation (location TBD)
- Integrate range of DER resource ownership/control models
  - Customer, third-party, aggregator, and SCE

Demo D Conceptual Diagram



Demo D Cost Overview

Demonstration D: SCE Implementation Cost Estimate		
Activity	**Est. Amount ($'000s)**	
Design and Engineering	$	400
Equipment and Services	$	10,500
Laboratory Testing	$	6,800
Field Equipment Deployment	$	3,300
Measurement & Validation (Data Analysis)	$	2,400
Project Management	$	250
Total	**$**	**23,650**

- Demo D is funded within SCE's existing EPIC project, the Integrated Grid Project
- The budget includes the design, lab testing, and field deployment of technologies that facilitate high penetration DERs including:
  - DER control and optimization applications
  - Field area network (FAN) for communications
  - Back-office and integration systems

Demo D Expected Outcomes

	Potential Demonstration Results
Reliability	• Potential to reduce the number and duration of service interruptions while limiting the size of an outage using automated protection devices • Potential to provide better grid operator visibility of the location and status of DER resources
Technology	• Demonstrate methods to securely share information between DER aggregator and SCE back office systems • Understand high speed field area network and its ability to distribute data to maximize the efficiency of the distribution grid • Demonstrate advanced field devices (substation and distribution), communications, control algorithms and utility back-office processing can create a system to allow for increased integration of DERs • Gain experience with an end-to-end cybersecurity system that allows DERs, controls, and utility automation equipment to operate safely and reliably
Capability	• Understand how an advanced controller can optimize a circuit's voltage profile and real and reactive power flow for high penetration DERs • Understand the maturity of DER products and associated services for incorporating best-of-breed applications • Improve the planning and operational capabilities with high penetration of DERs
Products/Services	• Understand how to Incorporate DER aggregators into markets for real and reactive power, grid voltage regulation and power flow optimization

Questions